General Time Update

David Thompson

Epics Collaboration Meeting

June 14, 2006

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

Status

- **Actually, since last year we have finished building an accelerator and since general time has worked so well we have forgotten about it.**
- **Timo and I were supposed to collaborate with the goal of adding the functionality into base.**

What General Time IS:

- A way to increase the reliability of IOCs, especially ones that use hardware time support.
- A way to work with high accuracy or beam synced timestamps with hardware that is not 100% reliable.
- A way to know when time is not OK.

What General Time IS NOT:

- A clock, watch-dog, or periodic trigger.
- A replacement, substitute, or enhancement to drvTS or other soft time systems.
- A new hardware time system such as IEEE1588.

How IOCs use time.

- Record support calls epicsTimeGetEvent() for time stamps.
- Device support and record scanning top level routines call epicsTimeGetCurrent() for scheduling.

However: there are four different implementations of these, one for each of posix/VMS, WIN32, RTEMS, and vxWorks.

- Only the vxWorks version provides hooks for hardware time or other soft time systems.
- NTP is used at boot up on vxWorks to set the local clock.
- An NTP task runs on vxWorks and WIN32.

How SNS Uses Time

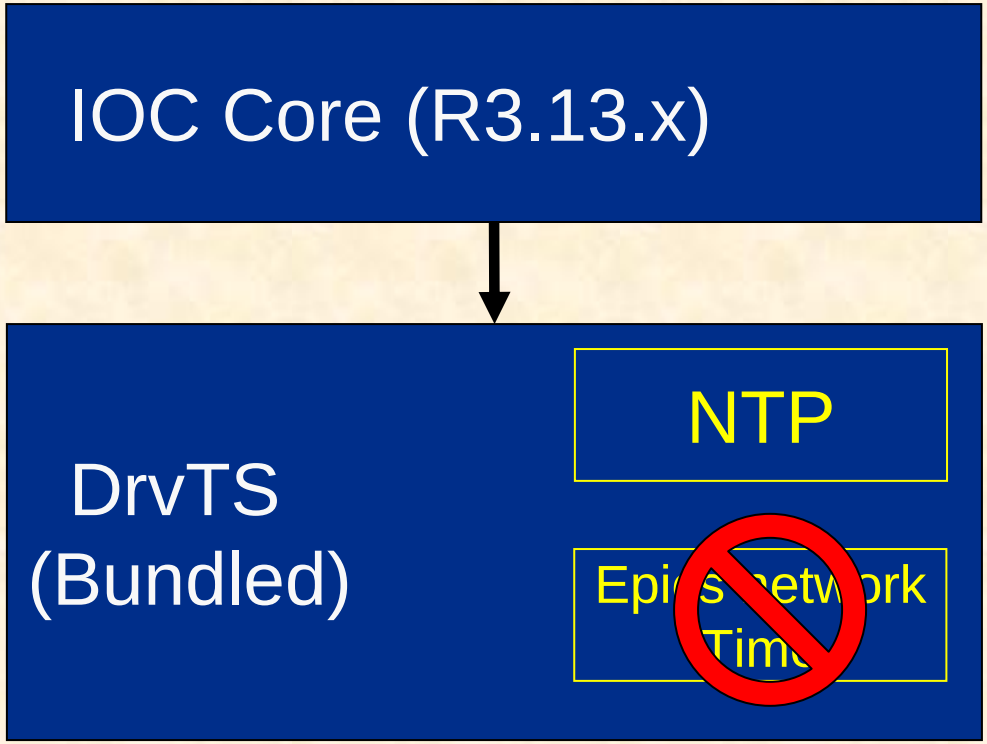
SNS is a pulsed neutron source designed to operate at 60 Hz. Diagnostics run at 1 and 6 Hz coordinated by the timing system.

- **SNS uses a beam sync time stamp, almost all data is time stamped based on the time of the current cycle. (16.7 ms granularity)**
- **Machine protection adds time from cycle start to the cycle time stamp for those status PVs that are used by the first-out application.**
- **Data to be analyzed is correlated using time stamps. We can look at the same beam pulse throughout the machine and all 64 bits of the time stamps match.**

So Why Did SNS Invent General Time?

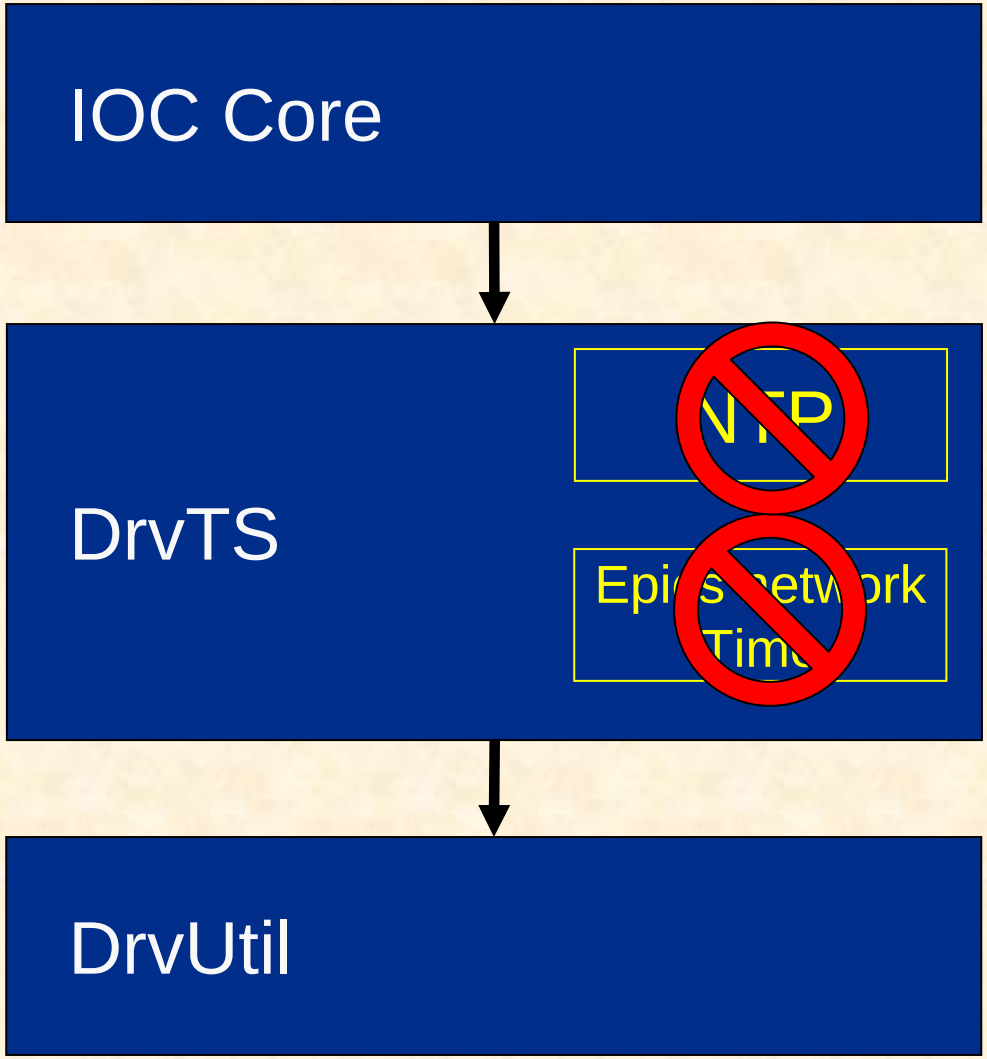
- At SNS we had some embarrassing timing system failures early on that caused bad time stamps to be stored in the archiver and globally disrupted processing of monitoring and PID loops.
- Local timing system distribution failures are a perpetual problem and were especially frequent during construction of SNS.
- We need the beam-sync time stamps for data correlation but can't have the timing system shutting down the cryoplant!!!

The Evolution (How do we get there?)



DrvTS could be configured for IOC time or NTP.

The Evolution

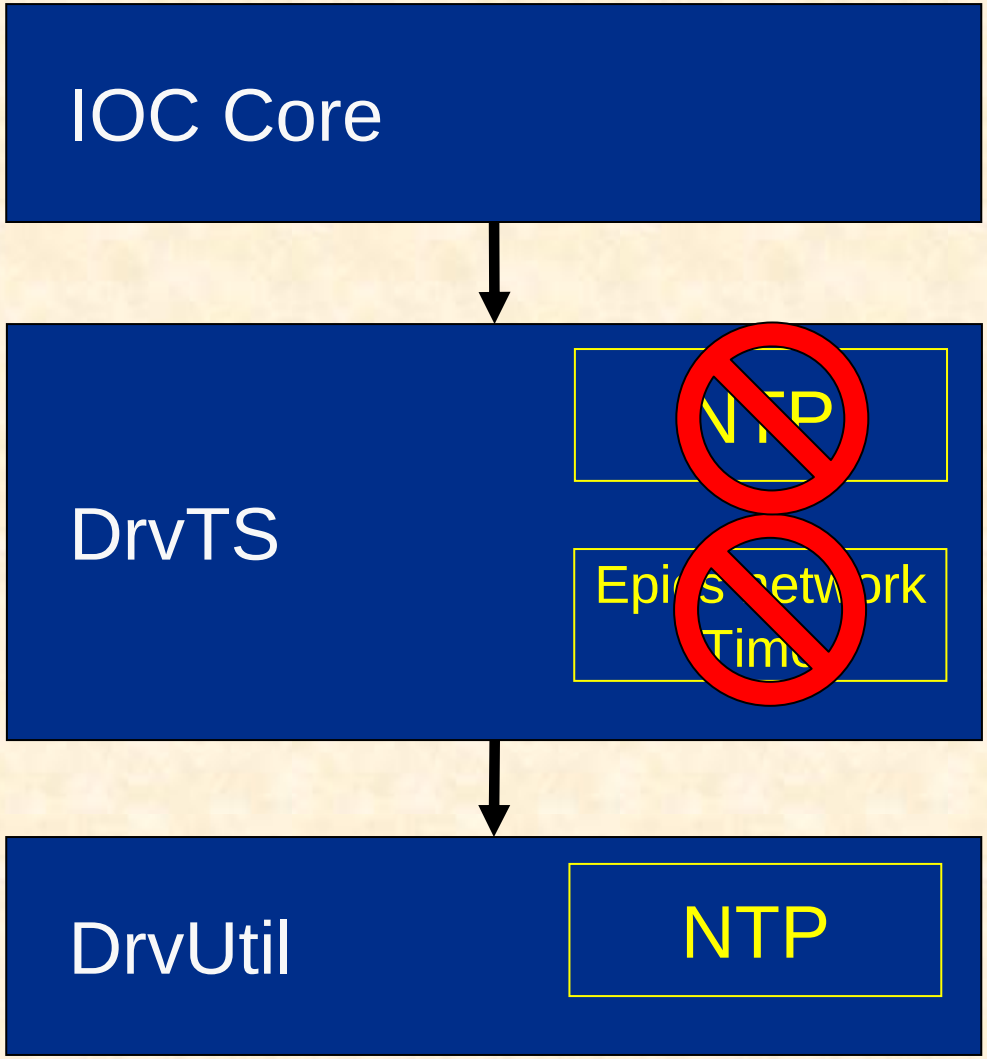


DrvTS calls ERGetTime() for external hardware time if Er* functions are found in the symbol table when drvTS is initialized.

Depends on load order to work.

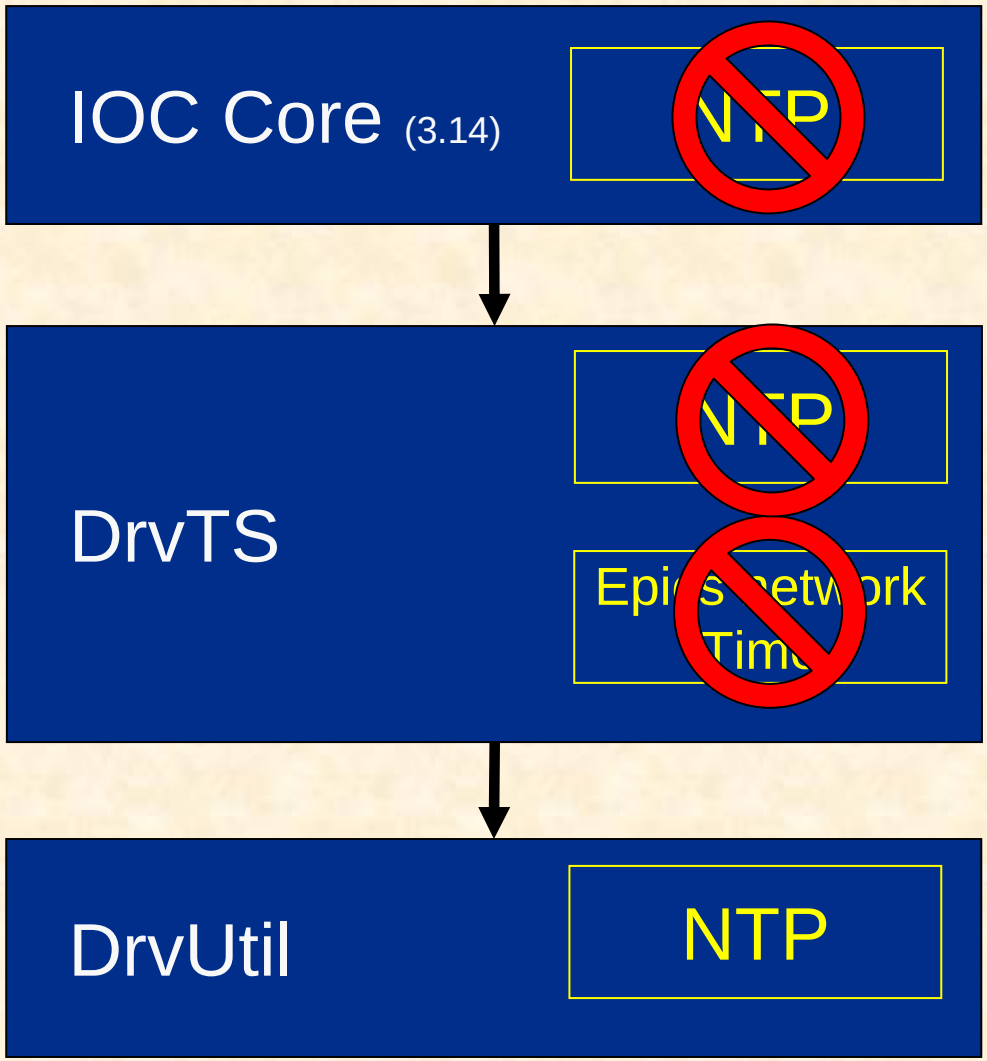
SNS uses a “Utility Module” to get real time data from the timing system. The driver extracts time stamps from the Real Time Data Link (RTDL).

The Evolution



NTP added to drvUtil to increase reliability when timing system has problems.

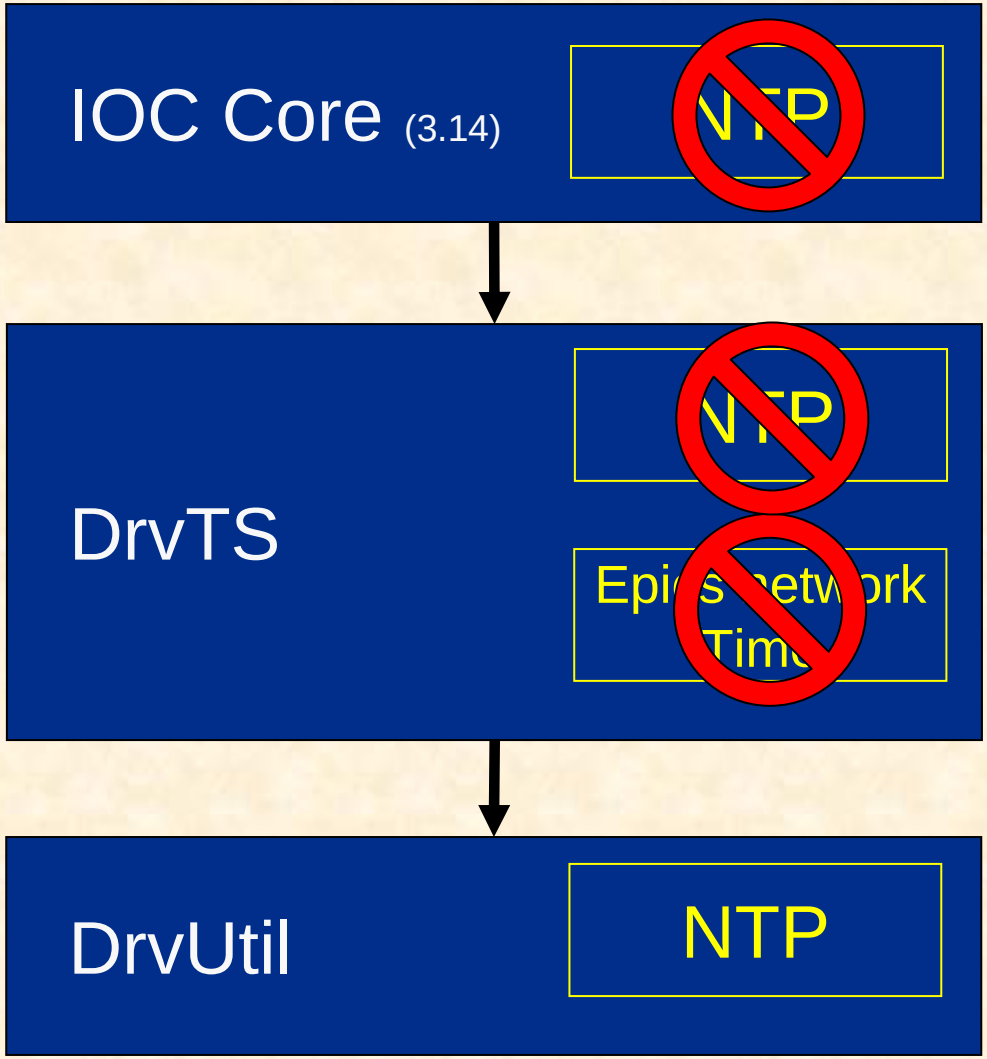
The Evolution



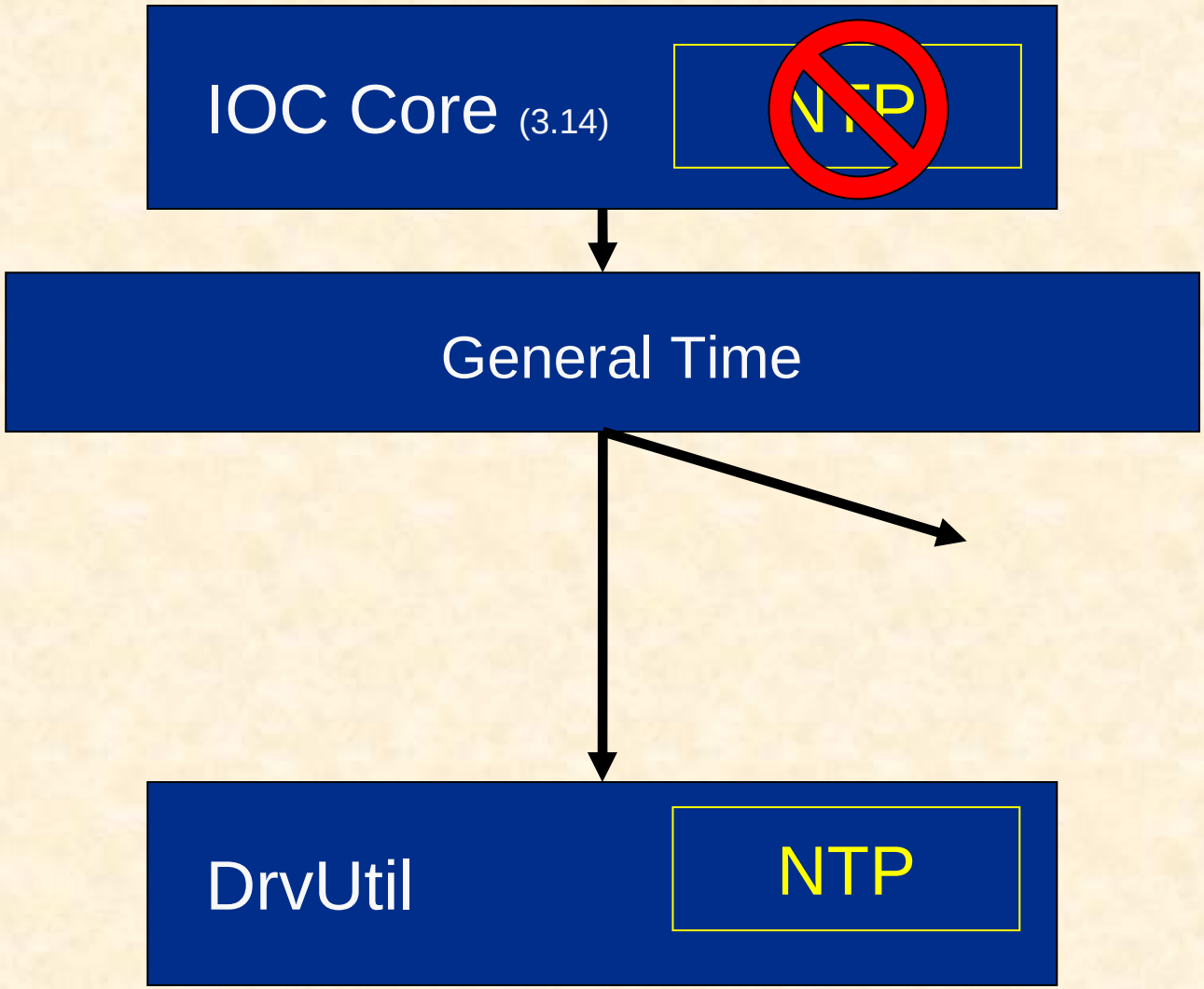
NTP added to IOC core at some point. Not usable when DrvTS is installed.

Don't need three NTP clients in the same IOC!

The Evolution



The Better Way

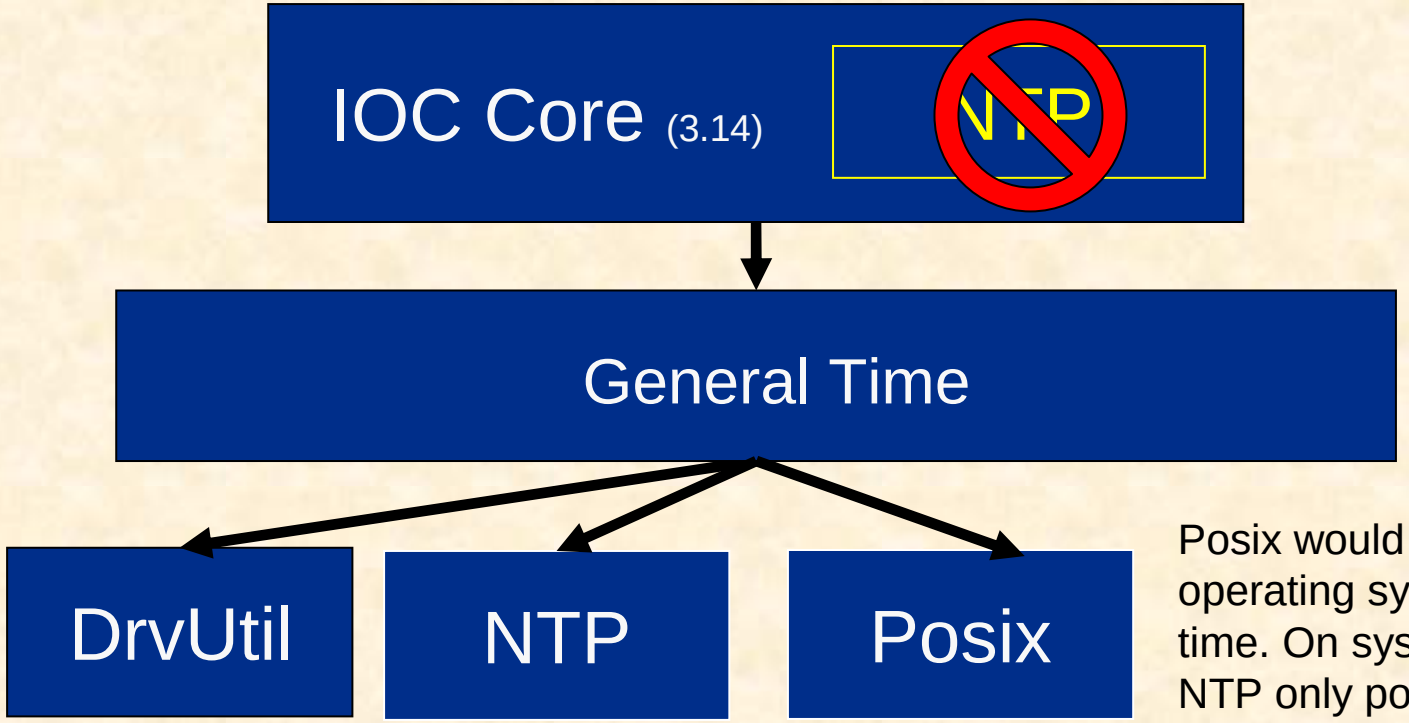


General Time Selects the Best Available Time

- Separate priority lists are kept for GetEvent() and GetCurrent().

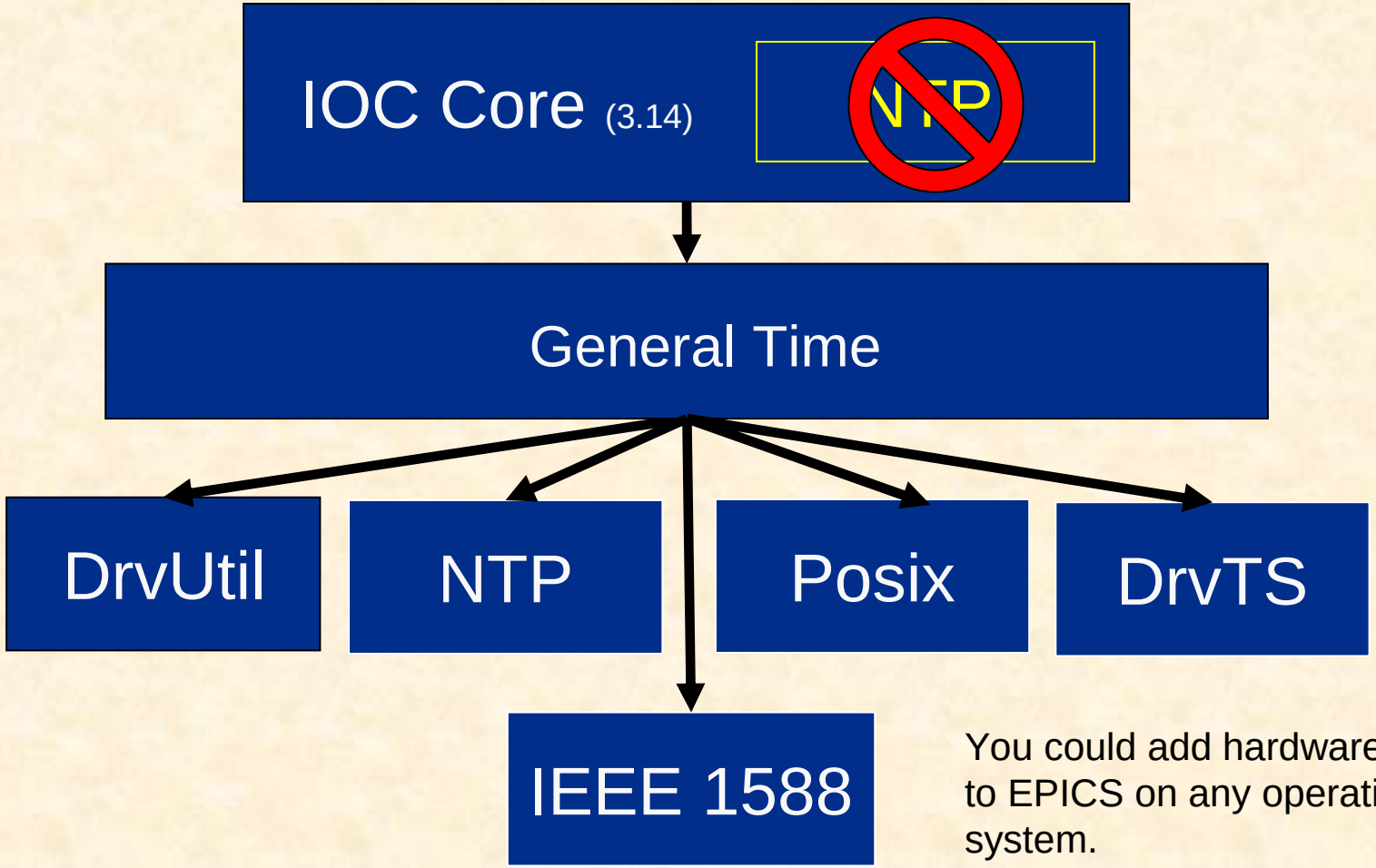
  Example:
  - For GetCurrent() drvNTP would be first selection.
  - For GetEvent() drvUtil would be first selection.
- Each time provider is a driver that has an init and report function.
- Each time provider has a GetEvent() function and a GetCurrent() function.
- Return status allows general time to drop to the next best provider in case of a failure.

General Time Accepts Add-Ins



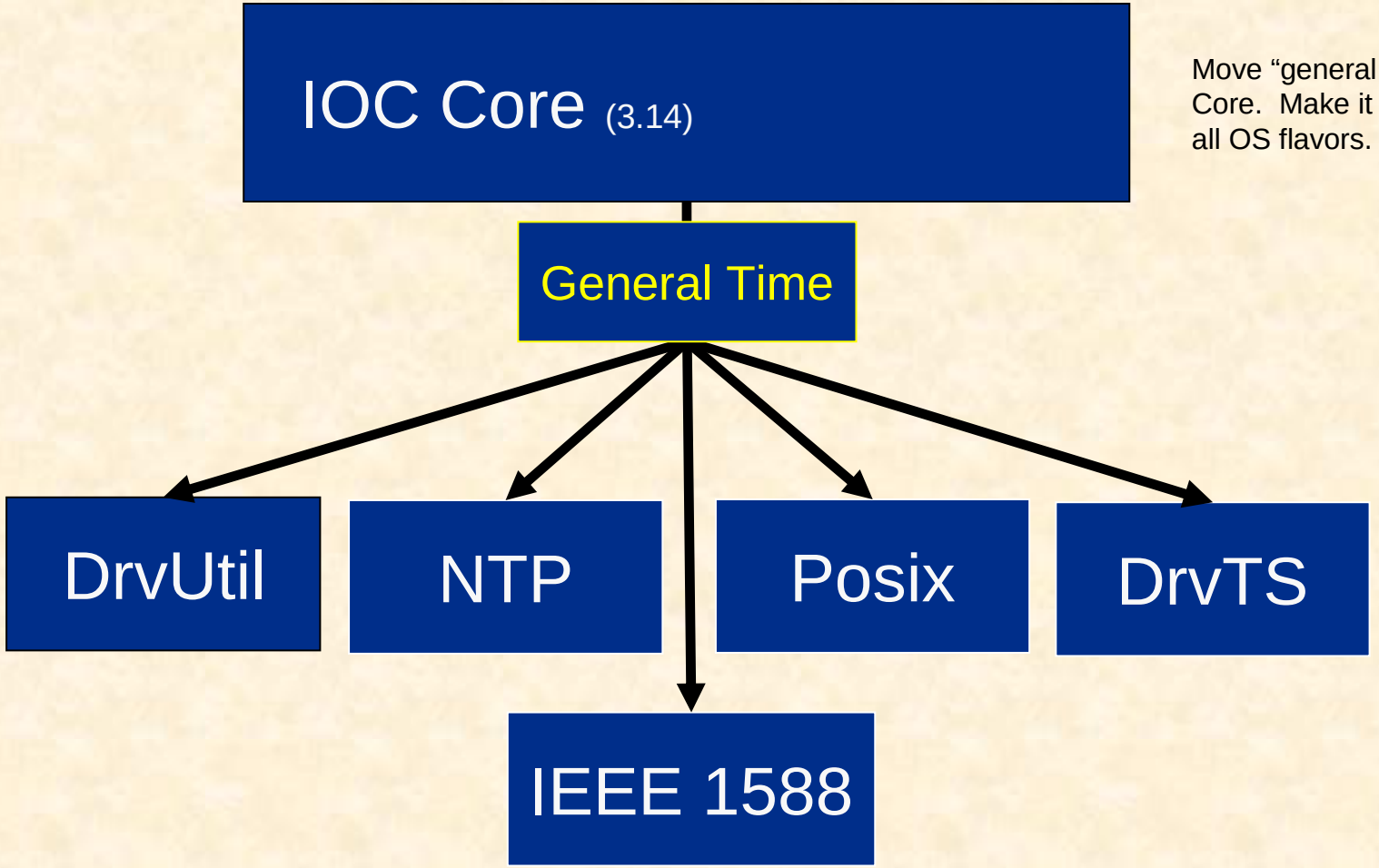
Posix would make generic operating system calls to get time. On systems with OS level NTP only posix is needed. (Everything BUT vxWorks.)

General Time Accepts Add-Ins



You could add hardware support to EPICS on any operating system.

The Next step:



Move “general time” to IOC Core. Make it available on all OS flavors.

Why Not Just Improve the EPICS NTP Client?

- NTP has limits that depend on the implementation in both the client and the sever.
- Someone might need something better, i.e IEEE 1588, and that might not be universally available.
- Maybe the issue is synchronization and not always absolute accuracy.
  - Time stamp the data not the time the record processed!

API Issues

- Don’t break anything!
- See Sheng Peng’s presentation from last year.
- General time is itself implemented as a driver and has device support for several status records.
- Time providers are implemented as drivers with a driver() dbd declaration and a driver entry table with init and report functions.
- As it is general time exports an interface so that a time provider can use to get on the priority lists.
- Initialization order does not affect run time behavior.
- This exists only on vxWorks but should be portable to all platforms.

Here's the deal:

- Bob asked me to do this, I asked Bob for a commitment to get the Core Committee to look at it.
- I can provide the source to generalTime.
- I have more time now to support it than I did last year.
- Something like this should be implemented in IOC Core but it does not have to be general time.